

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) Publication number:

0 644 483 A1

(12)

EUROPEAN PATENT APPLICATION(21) Application number: **93114714.4**(51) Int. Cl.⁶: **G06F 9/46, G06F 3/023**(22) Date of filing: **14.09.93**(43) Date of publication of application:
22.03.95 Bulletin 95/12(84) Designated Contracting States:
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D-70548 Stuttgart (DE)(54) **Computer system and method for performing multiple tasks.**

(57) The invention relates to a computer system and method for performing multiple tasks. The computer system comprises a host (2), a communication sub-system (3), a plurality of application programs (1, 2), virtual terminal manager (5), virtual terminals (9, 4), an application programming interface (6), and a cross application program (7) as well as a real terminal T. The logical connections L₁, L₂ of the application programs to their associated virtual terminals are independent from the logical connections of the respective virtual terminals to the real terminal T.

The logical connections L_{1T}, L_{2T} are user selectable by positioning of the software controllable switch 11. A plurality of application programs, for example applications programs (A₁, A₂), are integrated by the cross application program (7) which has access to the respective virtual terminals (4, 9) via the application programming interface (6) and the virtual terminal manager (5). The cross application program (7) can also be used for user simulation in order to automate the operation of the integrated application programs.

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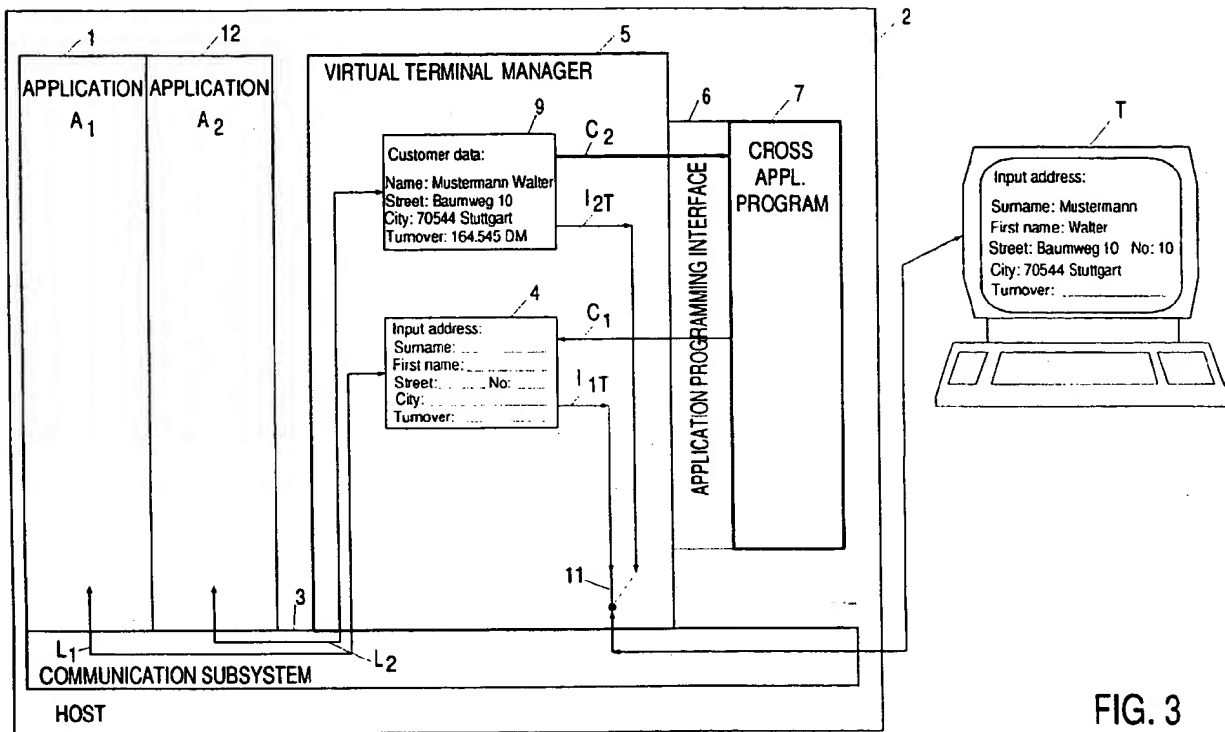


FIG. 3

The invention relates to a computer system for performing multiple tasks comprising at least one terminal, at least one application program and a communication subsystem. Further the invention relates to a method for performing multiple tasks in a computer system.

The prior art discloses a variety of inter-program communication methods in data processing networks comprising a host system connected to a plurality of terminals: The IBM System Journal, Vol. 22, No. 4, 1983 discloses a computer network with a communication subsystem which is the IBM system network architecture (SNA). On page 345 of that publication a network is defined as "a configuration of terminals, controllers, and processors and the links that connect them". When such a configuration supports user applications involving data processing and information exchange and conforms to the specifications of the system network architecture it is called an SNA network. Essentially SNA defines logical entities that are related to the physical entities in a network and specifies the rules for interactions among these logical entities. The logical entities of an SNA network include network addressable units and the path control network that connects them. Network addressable units communicate with one another using logical connections called "sessions". The three types of network addressable units (NAUs) are the logical unit (LU), the physical unit (PU), and the system services control point (SSCP) which are defined as follows:

Logical unit (LU). An LU is a port through which end users may access the SNA network. An end user uses an LU to communicate with another end user and to request services of a system services control point (SSCP).

Physical unit (PU). A PU is a component that manages the resources of a node in corporation with an SSCP.

System services control point (SSCP). This is a focal point for configuration management, problem determination and directory services for end users. SSCPs may have sessions with LUs and PUs. When such a session occurs, the LU or PU is in the domain of the SSCP. In addition to sessions with LUs and PUs, SSCPs may also communicate with each other to coordinate the initiation and the termination of sessions between logical units and in different domains.

From the hardware standpoint a simple network comprises a host system having a processing unit and a plurality of remote terminals that are assigned to individual users. The remote terminals are selectively connectable to the host system through one or more communication links. These links may comprise a coaxial cable, a dedicated telephone line or, in some cases, a satellite communication link.

The host processing unit must always have an operating system which supports the creation of a large number of virtual machines each of which is assigned, on request, to an end user. A virtual machine processes tasks for the assigned end user by time sharing the host processor hardware of the host system. Some host systems may include more than one hardware processor so that true simultaneous processing occurs at the host since a plurality of processors are running in parallel. More often, there is merely one hardware processor that "concurrently" runs data processing tasks for the virtual machines by a time sharing technique. This is transparent to the end users at the terminals.

Two general types of terminals are employed in data processing networks. The first is referred to as a "dumb terminal" in that it comprises merely a keyboard and a display device and little or no processing capability other than that required to make a connection with the host system. The second type of terminal is referred to as an intelligent work station (IWS) and is provided with its own processor unit and supporting peripheral devices. The terms IWS and personal computer (PC) are often used interchangeably. With the ready availability of PCs having very attractive price performance characteristics, most new networks are implemented with IWS-type terminals and many of the older networks are being modified with the replacement of dumb terminals with IWS-type terminals.

Providing each end user on the network with its own processing capability relieves the host CPU from doing many of the data processing tasks that were previously done at the host. The nature of the tasks that are processed by the host CPU therefore has changed and more sophisticated applications such as electronic mail and electronic calendaring are now implemented on the network under the control of the host system. Both of these applications involve what is referred to as distributed application programs, in that one part of the application program is resident on the host system and another is resident on the IWS terminal.

Many of the current data processing networks are designed in accordance with the IBM SNA architecture which was first described in 1974. Since then various new functions and services have been added. As suggested earlier, SNA networks can be viewed as a plurality of nodes interconnected by data links. At each of these nodes, path control elements send information packets, referred to as path information units (PIUs) between resource managers called logical units. These logical connections of the paths are called a session. A transport network for data is therefore defined by the path control elements and the data link control elements.

Nodes can be connected by a plurality of links and comprise a plurality of LUs. Various types of LUs sessions and protocols have been established within the framework of the SNA architecture. There are three general classes of sessions. The first class is unspecified by SNA. The second class involves terminals and the third involves program to program communication. For example, LU 6 provides SNA defined inter-program communication protocols which avoids the limitations of terminal LU types such as LU 2 and LU 7. LU 6.2 is referred to as advanced program to program communication or APPC protocols.

Logical units are more than message ports. LUs provide operating system services such as program to program communication involving one or more local programs. Each application program use the LUs as a local operating system and the network of loosely coupled LUs connected by sessions as a distributed operating system.

The LU allocates a plurality of resources to its programs, which are dependent on the particular hardware and its configuration. Some of the resources that are made available are remote while others are local, i.e., associated with the same LU as the application program. The sessions are considered local resources at each LU, but are shared between particular LUs.

The control function of an LU is resource allocation. Programs request access to a resource. Sessions which carry messages between LUs or programs running on LUs are considered to share resources. A session is divided into a plurality of serially executed conversations.

Two LUs connected by a session have a shared responsibility in allocating sessions to application programs for use as "conversations". The application programs are therefore sometimes referred to "transaction programs".

The successful connection between LUs occurs as a result of a common set of protocols which function first to activate a session between two LUs and second to facilitate the exchange of message data. A request to activate a session between two logical units is also called "BIND".

The SNA format and protocol reference manual designated SC 30-3112, published by the IBM Corporation, describes SNA by defining, for example, with programming language declarations, the format of messages that flow between network entities and the programs that generate, manipulate, translate, send and return messages.

The SNA transaction program reference manual for LU 6.2 referred to as GC 30-3084, published by the IBM Corporation, defines the verbs that describe the functions provided by the implementing products.

Even though SNA type communication subsystems are widely used other communication subsystems such as the transmission control protocol/internet protocol (TCP/IP) which is an UNIX-type/ethernet-based system-interconnect protocol are known from the prior art.

Fig. 1 shows a prior art example of a computer system in which an application program is logically connected via a communication subsystem to a terminal T. The computer system comprises at least a host 2 and a communication subsystem 3. The applications program A₁ is stored in storage space 1 of the host 2. The communication subsystem which is, for example, of an SNA or TCP/IP type, serves to establish a logical connection between the applications program A₁ and the terminal T. The communication subsystem 3 may comprise further host computers not shown in the drawing. The logical connection L between the applications program A₁ and the terminal T which is established via the communication subsystem 3 is also called a session.

A user of this prior art computer system is confronted with a problem of not being able to effectuate interrupt driven events at the user's command. For example, while a user is using the computer system for creating a report using an editor, the user may need to interrupt the word processing session and switch instantly to another program, such as to look up a phone number that resides in an application program that is different from the one the user is using as an editor.

Furthermore, in some cases it is necessary to input a large number of data via the terminal T on request of the applications program A₁, such as addresses of customers. If these data are present as a file stored on a storage medium of the computer system, it is desirable that the data be input to the applications program A₁ automatically without interaction of the user. However, in general, this is not possible without changing the applications program A₁ which expects the user to input the data via the terminal T on its request. In order to perform the task automatically, the applications program A₁ would have to be changed so that data can be inputted automatically from the file stored in the computer system without interaction of the user. In order to automate the task the applications program A₁ would have to be at least partially rewritten which normally involves a major effort in time and resources. Consequently, in some cases, the user has to perform the tedious task of inputting the data via the terminal T by hand. This is also disadvantageous since processing time of the computer system and the resources of the communication subsystem are wasted as the inputting of the data by hand requires a relatively long period of time as compared with the automatic data input

from the file.

It is therefore an object of the present invention to provide an improved computer system and an improved method for performing multiple tasks in a computer system.

The object of the present invention is solved by the features laid down in the independent claims. Preferred embodiments of the invention are given in the dependent claims.

According to the invention the data stream between the application program and the terminal is intercepted and routed to a virtual terminal. This is controlled by a virtual terminal manager.

The concept of virtual terminals is known as such, for example from US-A-5 109 510, EP-A-0 114 357 and Lantz et al, "Virtual Terminal Management in a Multiple Process Environment", 1979, Proceedings of the 7th Symposium on Operating System Principles, pp. 86-97. However, the prior art is silent as to the application of a virtual terminal concept in a computer system comprising a number of host computers being interconnected with one another and with terminals by an SNA, TCP/IP or similar type of communication subsystem.

According to the present invention the virtual terminal manager creates a true in-storage image of the display screen by analyzing the received data stream according to the actual data stream architecture, such as an SNA 3270 data stream. The in-storage image contains all information about content, layout, color and highlighting etc. of the real display screen.

The virtual terminal manager also performs all functions defined by the data communication protocol of the communication subsystem. Thus the virtual terminal simulates the appearance of a real terminal to an application program. It is completely transparent to the application program whether it works with a virtual terminal or a real terminal.

The virtual terminal manager provides a double interface to the communication subsystem in that it is possible for the application program and the real terminal to access the virtual terminal at the same time. The consistency of multiple access operations to the virtual terminal advantageously is controlled and monitored by the virtual terminal manager.

Since the virtual terminal manager receives the data stream prior to the real terminal, it can modify the virtual terminal buffer before sending the data to the real terminal. This modification can be:

- Conversion to different code standards, e.g. from EBCDIC to ASCII,
- conversion to different transmission protocols, e.g. from SNA to TCP/IP,
- conversion into another language code page,
- improved presentation of old application programs, e.g. by adding color etc.,

- usage of an application programming interface (API) provided by the virtual terminal manager to add data to the virtual terminal buffer,
- data transfer from other virtual terminals to a specific virtual terminal by usage of an API program,
- overlay of a message window on the user screen.

In an SNA type environment for example the virtual terminal manager simulates the functionality of one or more LUs as required. Thus a logical connection is establishable via the SNA communication subsystem between the application program and its dedicated virtual terminal. This logical connection in principle is independent from the existence of another logical connection between a real terminal and the dedicated virtual terminal since the dedicated virtual terminal appears to the application program as real terminal. Thereby background operation is made possible.

The invention is advantageous in that it allows multiple sessions to share one real terminal device. When a user switches sessions by using a "hot key" function, the virtual terminal manager allows the access to the data of the new virtual terminal for the real device, still maintaining all other active virtual terminals in the background. Further, updates of virtual terminal buffers which are currently not displayed on a real terminal are made possible as well as the display of partial data of two or more virtual terminal buffers on the real terminal. This allows a user to view more than one host session on his screen.

The virtual terminal manager provides an API interface for each virtual terminal. This allows the writing of programs which can modify virtual terminal buffers before they are displayed on the real terminal. It also may simulate user input providing for an automated operation. This automated operation may even act on screen content of the dedicated virtual terminal of one applications program to provide an answer to a request of another applications program.

In the following a preferred embodiment of the invention is described in more detail with reference to the drawing in which

- Fig. 1 is a schematic diagram of a prior art computer system,
- Fig. 2, 3, 4 is a schematic diagram of preferred embodiments of the computer system according to the invention,
- Fig. 5 is a schematic diagram showing the correlation of multiple sessions,
- Fig. 6 is a flow-chart illustrating the establishment of a session,

Fig. 7 is a schematic diagram showing the usage of a cross application program according to the invention.

The inventive computer system shown in Fig. 2 differs from the prior art computer system of Fig. 1 in that it additionally comprises a virtual terminal 4, a virtual terminal manager 5, an application programming interface 6 belonging to the virtual terminal manager 5 and a user simulation program 7. A logical connection L_1 is established between the applications program A_1 and its dedicated virtual terminal 4 via the communication subsystem 3. A logical connection I_{1T} is established between the terminal T and the dedicated virtual terminal 4 of the applications program A_1 . The data stream coming from the applications program A_1 via the logical connection L_1 is processed by the virtual terminal function. The data is thereby stored as a screen image which is always a true copy of a real screen buffer, including the extended attribute buffer. In this example, each session is under the control of the IBM virtual telecommunications access method VTAM preferably featuring IBM's advanced communication functions. The virtual telecommunications access method (VTAM) is a set of IBM programs that control communication between terminals and application programs and which cooperates with SNA. The virtual terminal manager makes usage of VTAM for the establishment of the logical connections.

If the logical connection I_{1T} between the terminal T and the virtual terminal 4 is no longer maintained, this is not transparent to the applications program A_1 , since the logical connection L_1 is adapted to be maintained independently from the existence of the logical connection I_{1T} . If the applications program A_1 requires input from the user, this input operation is carried out automatically by the user simulation program 7. The user simulation program 7 has access to the virtual terminal 4 and in particular to the virtual terminal buffer of the virtual terminal 4 which comprises a true in-storage image of the real screen.

Since the virtual terminal buffer is held preferably in the main memory of the computer system the user simulation program 7 constantly monitors the contents of the virtual terminal buffer. The user simulation program 7 accesses the virtual terminal buffer via the application programming interface 6 of the virtual terminal manager 5. The application programming interface 6 provides all necessary functions to access the virtual terminal buffer. The user written user simulation program 7 gets access to the virtual terminal 4 through the application programming interface 6 provided by the virtual terminal manager 5. The application programming interface provides the following function requests:

- Establishment and control of the application and terminal sessions L_i , I_{iT} (in this example L_1 and I_{1T}).
- Establishment and control of the virtual terminals.
- If a plurality of virtual terminals is established by the virtual terminal manager 5: Control which virtual terminal is displayed on the real terminal T and exchange of data between the user simulation program and different ones of the virtual terminals.

The function requests are used for the programming of the user simulation program 7 which may be written in an interpreter language like REXX or a compilable normal language like PL/1 or C. The application programming interface 6 provides a way to control the access of multiple user simulation programs 7 running concurrently to the virtual terminals of the virtual terminal manager 5 by maintaining a logical connection between a virtual terminal - for example virtual terminal 4 and logical connection C_1 - and the user simulation program 7 on demand of the user simulation program 7. This is according to an algorithm depending on the requirements of the specific application and is implemented in the user simulation program 7.

To keep the screen image in a virtual terminal consistent with the requirements of the application, the user simulation program 7 is not allowed to change the screen layout when acting as an operator. The user simulation program 7 can only alter the contents of the virtual terminal buffer when a user would be allowed to enter data on the real terminal. The virtual terminal manager assures the consistency by rejecting invalid access requests to the virtual terminal buffer via the application programming interface 6.

The computer system of Fig. 3 additionally comprises a further applications program A_2 which is stored in storage space 12 in the host 2, a dedicated virtual terminal 9 of the applications program A_2 and a switch 11 which is realized by the software of the virtual terminal manager 5 and the application programming interface 6. Logical connection C_2 is established between virtual terminal 9 and user simulation program 7 which in this example is a cross application program 7. The cross application program 7 serves to integrate two or more applications programs. This is explained in more detail in the following:

A logical connection L_2 is established between the applications program A_2 and the dedicated virtual terminal 9 via the communication subsystem 3. The logical connection I_{1T} in this case is established via the communication subsystem 3 and the switch 11. If the position of switch 11 is changed, another logical connection I_{2T} is established be-

tween the virtual terminal 9 and the terminal T. The position of the switch 11 is changed on request of the user of the terminal T by issuing a corresponding command via the logical connection l_{1T} to the virtual terminal manager.

The position of switch 11 can also be changed on request of the user simulation program 7 which in this example is a cross application program.

First the case is considered in which the user is working with the applications program A_1 . Therefore the logical connections L_1 and l_{1T} are established. The applications program A_1 requests the input of customer data, for example, name, street, city and turnover from the user. In order to find out the turnover of a specific customer the user must work with a second applications program A_2 in order to gain access to a data base. Thus the user requests that the position of switch 11 be changed in order to establish the logical connection l_{2T} . This is done by issuing a corresponding command from the terminal T to the virtual terminal manager 5, preferably by making use of a "hot key".

Once the logical connection l_{2T} is established the user inputs the name and address of a specific customer in order to find out the turnover of that customer by means of applications program A_2 . In response to a user request the switch 11 is shifted back into its starting position so that again the logical connection l_{1T} is established. The user may now input all of the required customer data - including the turnover - into applications program A_1 .

If an SNA 3270 data stream is used, the data streams in the communication subsystem 3 consist of user-provided data and commands that logical units transmit over an LU-session. Logical units also transmit control information that governs the way the data is handled and formatted. The SNA 3270 data stream is the only data stream that LU types 2 and 3 use. It is an optional data stream for LU types 6.1 and 6.2. The data stream supports file-to-file transfer, display applications, and printer applications.

Generally, an application program communicates with a display operator using one of two methods:

In the first method, the application program leaves the display surface unformatted, and the operator uses it in a free-form manner. In the second method, the application program completely or partially formats the display surface (i.e. organizes or arranges it into fields) and the operator enters data into the fields. The second method is used in the example shown in Fig. 3 since the display operator - especially the user of the terminal T - is only allowed to input data at specified positions in the virtual terminal buffers of the application programs A_1 , A_2 .

The SNA 3270 data stream allows the application programmer to divide the display surface into one active area, and, optionally, one or more reference areas. Each area is called a partition. The partition that is "active" contains a cursor and is the only partition in which the operator can enter data or requests.

The second case considered here is that of user simulation program 7 which in this example is a cross application program. If the cross application program 7 is running, the above described procedure of the first case is carried out automatically. If the applications program A_1 requests the customer data and especially the turnover to be inputted, this is recognized by the cross application program 7 via the logical connection C_1 . As a consequence the cross application program 7 inputs the name and address of a specific customer via logical connection C_2 to the virtual terminal 9 of the applications program A_2 and observes the virtual terminal buffer of the virtual terminal 9 for the result of the query in the data base of the applications program A_2 which yields the required turnover of the customer. This number is read from the virtual terminal buffer of applications program A_2 and transferred to the cross application program 7 via the logical connection C_2 . The cross application program 7 inputs the turnover automatically via logical connection C_1 to virtual terminal 4. On the next request of the applications program A_1 the same sequence of operations is carried out again automatically. This is done without interaction of the user. The user may observe any one of the application programs if a logical connection l_{1T} or l_{2T} to one of the virtual terminal buffers is established via switch 11.

The computer system of Fig. 4 additionally comprises an independent virtual terminal 14. The independent terminal 14 is dedicated to the cross application program. The independent virtual terminal 14 is observed by the user of terminal T since a logical connection C_T is established via switch 11 and communication subsystem 3 between the independent virtual terminal 14 and terminal T.

If for example the applications program A_1 requires the customer identification number (ID) in order to access customer data, such as turnover, outstanding claims of unpaid bills and the date of the last reminder, the applications program A_1 requests a customer ID to be inputted. This is recognized by the cross application program 7 which is connected with the virtual terminal 4 of applications program A_1 , since the cross application program 7 observes the virtual terminal buffer of the virtual terminal 4. If the applications program A_1 requires the input of a customer identification number which is not known to the cross application program, the cross application program accesses the applica-

tions program A₂ by the logical connection C₂. Name and address of a specific customer is input into the virtual terminal buffer of the virtual terminal 9, the data base of applications program A₂ is queried and the result is returned to the virtual terminal buffer of the virtual terminal 9. Then the cross application program 7 inputs the required customer ID which is found out by means of the applications program A₂ into the virtual terminal 4 of the applications program A₁. The information provided by applications program A₁ is monitored by the cross application program via the logical connection C₁. In the example shown in Fig. 4 the cross application program 7 recognizes that there are outstanding claims. This relevant information is output via logical connection L_c to the independent virtual terminal 14. Thus the user of the computer system is only notified as to a specific customer if there are outstanding claims of unpaid bills of that customer.

The independent virtual terminal 14 is provided by the virtual terminal manager 5. The independent virtual terminal 14 is not in session with an application program. This allows the set-up of a screen layout which is determined by the cross application program 7. In this case the cross application program 7 controls the session to the real terminal via logical connection C_T. Thereby it is possible to define any screen layout to present a new interface to the user of the terminal T. The screen layout may combine the outputs of two or more application screens as it is shown in the figure.

In summary, a user simulation program 7 therefore may perform one or more of the following tasks:

- simulation of user input to an application program for frequently repeated tasks (cf. the preferred embodiment shown in Fig. 2),
- integration of data obtained from virtual terminal buffers which hold a true in storage screen image of currently invisible application programs; the data is integrated into the screen of the currently displayed application program (cf. the preferred embodiment of Fig. 3),
- provision of a new user interface to one or more application programs by providing a new screen layout in an independent virtual terminal (cf. the preferred embodiment of Fig. 4).

This approach is particularly advantageous in that it provides application program-to-application program communication without any change to the effective programs.

The appearance to the end user of one or more application programs can be changed without changing the application programs themselves. The user simulation program 7 or the cross application

program 7 can be written by the user without any impact on the communication subsystem 3 of the computer system. Furthermore, the programmer of the user simulation program 7 or the cross application program 7 does not have to have any knowledge about the nature of the data stream. This is because a user simulation program 7 can directly access the screen of an application program by access to the corresponding virtual terminal buffer using the API function requests defined by the application programming interface 6. Furthermore, this approach is advantageous since it allows for running the same user simulation program 7 or cross application program 7 concurrently multiple times, each serving a different user of a different terminal T with different virtual terminals involved.

Furthermore, the present invention is particularly beneficial because the communication subsystem 3 is used more efficiently. Whenever a jump, escape or similar type of operation requires the saving of a current screen content only the newly modified data has to be added to virtual terminal buffer of the application program which is in session with the terminal T. No full screen read operation must be issued if, for example, the switch 11 is activated in order to change sessions. This is because virtual terminal buffers always keep a true in-storage image of the real screen in the main memory of the computer system. A jump operation from one application program to another - i.e. changing the position of switch 11 in Fig. 3 - or an escape operation where no session with the real terminal T is maintained, only necessitates that the newly modified data which was modified after the last enter command of the user be added to the virtual terminal buffer of the application program from which the jump or escape operation is carried out. When the screen of that application program has to be restored later on to the real terminal T, the corresponding virtual terminal being assigned to that application program will generate a data stream - such as an SNA 3270 data stream - out of its saved virtual terminal buffer and send it to the real terminal. This step is advantageously carried out by making usage of VTAM. In this case only a pointer to the storage location where the virtual terminal buffer of that application program is stored has to be sent to the real terminal. This also improves the operation of the communication subsystem, since transmission time is saved. Consequently switch 11 can be activated very frequently without blocking the communication subsystem 3.

Fig. 5 shows a more detailed view of the computer system shown in Fig. 3. The user simulation program 7 is not shown in Fig. 5. The computer system shown in Fig. 5 additionally comprises with respect to the computer system of Fig. 3 an addi-

tional virtual terminal 15. Each of the virtual terminals 4, 9, 15 comprises a control block B₁, B₂, B_T and a virtual terminal buffer VTA₁, VTA₂, VTT₁, respectively. The switch 11 is interposed between virtual terminals 4, 9 which are dedicated to an application program and the virtual terminal 15 which is dedicated to the real terminal T.

The virtual terminal 15 of the real terminal T is already generated when the computer system is switched on. Preferably the computer system is controlled by the IBM program Netview Access Services or a similar product which manages the establishment of interconnections between the components of the computer system. First, the selection menu of Netview Access Services is shown on the real terminal T or in other words the selection menu is stored in the virtual terminal buffer VTT₁. This corresponds to step 60 of the flow-chart shown in Fig. 6. In the terminal control block BT resource identification table (RIDT) is stored. The RIDT comprises a pointer P_T which points to the virtual terminal buffer VTT₁.

Then the user of the real terminal T selects an applications program A_i of the application programs present in the computer system from the selection menu shown on virtual terminal 15 (step 61). This request of the user to work with the applications program A_i is transferred to applications program A_i (step 62). This transfer is preferably accomplished by means of the IBM program Netview Access Services. The applications program A_i tests whether it can fulfil the user request.

If this is the case an empty control block is selected and marked with an identifier so that this control block becomes the control block B_i of the applications program A_i (step 63). Then a logical connection I_{1T} is established between the dedicated virtual terminal VT_i of the applications program A_i and the real terminal T by putting switch 11 into the required position (step 64). In the example shown in Fig. 5 the applications program A₁ is selected by the user and the switch 11 is put into a position so that the logical connection I_{1T} is established. The function of the switch 11 is realized by storage of a first pointer P_{1T} in the control block B₁. The pointer P_{1T} points to the control block BT of the real terminal T. A second pointer P_{Ti} is stored in the control block BT. The second pointer P_{Ti} points to the control block B_i of the applications program A_i which is selected by the user. In the example shown in Fig. 5 the pointer P_{Ti} is thus pointing to the control block B₁ of the selected applications program A₁.

Each control block B_i, B_T - which is not an empty control block - comprises a resource identification table RIDT. Data as to the resources allocated by the LU - which is simulated by the virtual terminal manager 5 - to the applications

program A_i or the real terminal T is stored in the RIDT of the corresponding control block B_i or B_T.

Each resource identification table in each of the control blocks B_i, B_T comprises storage fields to indicate the actual state of the virtual terminal buffer VTA_i of the virtual terminal VT_i to which the control block B_i belongs. These storage fields comprise data as to the screen size, the number of rows and columns of the screen, the cursor position and other hardware characteristics. These data are inputted into the resource identification tables of the control blocks B_i, B_T by a "BIND" request of the corresponding applications program A_i or the virtual terminal T, respectively.

The virtual terminal 15 of the real terminal T is optional. If no selection menu is used, virtual terminal buffer VTT₁ is obsolete. However the control block BT is still required to store the second pointer P_{Ti}. If a new logical connection I_{1T} between a virtual terminal VT_i of one of the application programs i and the real terminal T is established, the contents of virtual terminal buffer VTT₁ is no longer displayed on the real terminal T, but the contents of the virtual terminal buffer VTA_i - in the example shown in Fig. 5 the contents of VTA₂ - of the applications program A_i which is newly selected. If the user requests another application program - for example the applications program A₂ - the position of the switch 11 is changed correspondingly as indicated by the dashed lines in Fig. 5. Thereby the logical connection I_{2T} is established.

The case that the user requires a change from the presently selected applications program A₁ to the applications program A₂ is considered by way of example. The following sequence is carried out:

Firstly real terminal T shows the screen of the applications program A₁ or in other words the virtual terminal 4 of that applications program A₁ is displayed on the real terminal T. Then the user presses a "jump" key in order to indicate the request to change from applications program A₁ to applications program A₂. The pressing of the "jump" key implies that the newly modified data stored in the data buffer of the real terminal T are stored in the virtual terminal buffer VTA₁ so that the virtual terminal 4 holds the latest update of the screen contents of the real terminal T before the applications program A₁ is left.

Secondly the first pointer P_{1T} is changed to be a null pointer in order to indicate that the logical connection I_{1T} is no longer established. The second pointer P_{Ti} is changed so that it points to the control block B₂ of the newly selected applications program A₂. The pointers P_{Ti} of the application programs i are stored in an ordered table so that the corresponding pointer P_{T2} which is required for changing the position of switch 11 is obtained from that table. That table is established under the con-

trol of the virtual terminal manager 5. If there is more than one real terminal T there is a multiplicity of first pointers $P_{T\pi}$ since each terminal T requires a different first pointer $P_{T\pi}$. The first pointers are also stored in an ordered table. This table is accessed by the virtual terminal manager 5 in order to read the required first pointer $P_{T\pi}$ - in this example the pointer P_{2T} - which points to the terminal control block BT of the terminal T from which the request to access applications program A_2 is issued. The pointer P_{2T} is stored in the control block B_2 by the virtual terminal manager 5.

Thirdly - in the example shown in Fig. 5 - an SNA 3270 data stream is generated from the data stored in the virtual terminal 9. This data stream is transmitted to the real terminal T which consequently shows the screen of the applications program A_2 .

Fig. 7 shows a more detailed view of the computer system of Fig. 4. Once the cross application program 7 is started the program establishes logical connections C_1 , C_2 , C_T by means of the application programming interface 6 and the virtual terminal manager 5 to the virtual terminals 4, 9, 15 and especially to the control blocks B_1 , B_2 , BT in order to gain access to the corresponding virtual terminal buffers VTA_1 , VTA_2 , VTT_1 . Data from these virtual terminals can be composed by cross application program 7 to a new screen which is stored in the independent virtual terminal 14 of the cross application program 7. The screen stored in independent virtual terminal 14 can be transmitted by issuing an appropriate application programming interface command from the cross application program 7 via the logical connection C_T to the virtual terminal 15 for display on the real terminal T. The issuing of the command is indicated by the dotted line in Fig. 7.

The preferred embodiment of Figs. 4 and 7 is particularly beneficial for the integration of applications programs. If a plurality of applications programs is given - such as applications programs A_1 and A_2 - these are combined by the cross application program 7 in the following way:

- a) One applications program A_i of the plurality of applications programs is selected, i.e. a logical connection C_i to the corresponding virtual terminal VT_i of that applications program A_i is established. Further, the cross application program 7 observes the virtual terminal VT_i . This is done by observation of the virtual terminal buffer VTA_i of the virtual terminal buffer VT_i . The cross application program 7 observes the virtual terminal buffer VTA_i by making usage of the function requests provided by the application programming interface.
- b) If the applications program A_i requests the input of information, this is recognized by the

cross application program 7 due to its observation of the virtual terminal VT_i . In response to this request of information by the applications program A_i the cross application program 7 selects another applications program A_j which can provide for the requested information.

c) Consequently, a logical connection C_j to the corresponding virtual terminal VT_j of that applications program A_j is established.

d) The applications program A_j is requested by the cross application program 7 to provide for the information which is requested by the applications program A_i (cf. step b). This is done by inputting a corresponding query request via the logical connection C_j to the virtual terminal VT_j of the applications program A_j .

e) The cross application program 7 observes the virtual terminal VT_j by observation of the virtual terminal buffer VTA_j . Once the requested information is present in the virtual terminal VT_j , this information is outputted via the logical connection C_j to the cross application program 7. Again the cross application program 7 accesses the virtual terminal - in this case VT_j - by the function requests provided by the application programming interface 6. The requested information is inputted via the logical connection C_i into the virtual terminal VT_i of the applications program A_i .

f) The cross application program 7 observes the virtual terminal VT_i of the applications program A_i for the response of the applications program A_i to the input of the requested information.

g) Once the response of the applications program A_i to the input of the requested information is present, this response is outputted via the logical connection C_i to the cross application program by means of the application programming interface 6. The response of the applications program A_i is tested whether it fulfills a predefined criterium. In the example of Fig. 4 the predefined criterium is whether there are outstanding claims or not.

h) If the predefined criterium is fulfilled by the response, a logical connection L_c is established between the cross application program 7 and its independent virtual terminal VT_c 14. The response of the application program A_i is inputted into the independent virtual terminal VT_c 14 via the logical connection L_c . Additional textural information can be added in order to explain the response to the user (cf. the textural information in the independent virtual terminal 14 shown in Fig. 4).

i) The switch 11 is put into a position so that a logical connection C_T is established between the independent virtual terminal VT_c 14 and the terminal T. The user is thereby notified of the

response of the applications program A_i since the independent virtual terminal VT_c 14 is displayed on the terminal T.

Preferably a look-up table is stored in the computer system for the selection in the above step b). This look-up table assigns a requested information to a specific applications program which can provide for the requested information. Therefore each table entry is a pair of a requested information and the corresponding program which can provide for the requested information. In the above described step b) this table is accessed in order to find and select the applications program A_j which can provide for the information requested by the applications program A_i .

Claims

1. Computer system for performing multiple tasks, said computer system comprising at least one terminal T, at least one applications program A_i and a communication subsystem (3),
characterized in that
a dedicated virtual terminal VT_i (4) is assignable to said applications program A_i ,
a logical connection L_i is establishable via said communication subsystem between said applications program A_i and its dedicated virtual terminal VT_i (4, 9), and in that
said logical connection L_i is adapted to be maintained independently from the existence of a logical connection l_{iT} between said terminal T and said dedicated virtual terminal VT_i .
2. Computer system according to claim 1, characterized in that
said dedicated virtual terminal VT_i (4) having a dedicated control block B_i assigned thereto,
said terminal T having a dedicated terminal control block BT assigned thereto,
wherein said logical connection l_{iT} between said terminal T and said dedicated virtual terminal VT_i is establishable by storage of a first pointer P_{iT} in said control block B_i and storage of a second pointer P_{Ti} in said terminal control block BT, said first pointer P_{iT} pointing to said terminal control block BT and said second pointer P_{Ti} pointing to said control block B_i .
3. Computer system according claim 2, characterized in that said first pointer P_{iT} being a null pointer if said logical connection l_{iT} between said terminal T and said dedicated virtual terminal VT_i is not established.
4. Computer system according to any one of the preceding claims, characterized in that a dedicated virtual terminal VT_T is assigned to said terminal T and said terminal control block BT preferably comprises a virtual terminal pointer P_T which points to said dedicated virtual terminal VT_T of said terminal T.
5. Computer system according to any one of the preceding claims, characterized in that said computer system further comprises a user simulation program (7) and a dedicated virtual terminal VT_c (14) which is assigned to said user simulation program,
whereby a logical connection C_i (C_1 , C_2) between said user simulation program and said dedicated virtual terminal VT_i of said application program is establishable under to the control of said user simulation program, and
a logical connection C_T between said terminal T and said dedicated virtual terminal VT_c is establishable
6. Computer system according to claim 5, characterized in that said logical connection C_i between said user simulation program and said dedicated virtual terminal VT_i of said applications program A_i is establishable by storage of a third pointer P_{ic} in said control block B_i and storage of a fourth pointer P_{ci} in a storage location which is assigned to said user simulation program, said third pointer P_{ic} pointing to said user simulation program and said fourth pointer P_{ci} pointing to said program specific control block B_i .
7. Computer system according to claim 5 or 6, characterized in that said logical connection C_T between said terminal T and said dedicated virtual terminal VT_c of said user simulation program is establishable by storage of a fifth pointer P_{TC} in said terminal control block BT and by storage of a sixth pointer P_{CT} in a storage location assigned to said user simulation program, said fifth pointer P_{TC} pointing to said user simulation program and said sixth pointer P_{CT} pointing to said terminal specific control block BT.
8. Computer system according to any one of the preceding claims, characterized in that said computer system comprises a plurality of host computers and at least two applications programs A_i , A_j which are stored on different ones of said host computers, each of said applications programs A_i , A_j having a dedicated virtual terminal VT_i , VT_j (4, 9) assigned thereto,
said dedicated virtual terminals VT_i , VT_j being stored in one of said host computers.

9. Computer system according to any one of the preceding claims, characterized in that said logical connections are establishable by means of a virtual telecommunications access method.

10. Method for performing multiple tasks in a computer system, said computer system comprising a terminal T and a plurality of application programs and a communication subsystem (3), said method being characterized by the following steps:

- a) selecting an applications program A_i out of said plurality of application programs,
- b) establishing of a logical connection L_i via said communication subsystem between said applications program A_i and a dedicated virtual terminal VT_i (4, 9),
- c) establishing a logical connection I_{iT} between said terminal T and said dedicated virtual terminal VT_i , and
- d) maintaining said logical connection L_i independently from the existence of said logical connection I_{iT} .

11. Method according to claim 10, characterized in that said logical connection L_i is established by

- a) assigning a dedicated control block B_i - (B_1 , B_2) to said dedicated virtual terminal VT_i ,
- b) assigning a dedicated terminal control block BT to said terminal T,
- c) storing a first pointer P_{iT} in said control block B_i ,
- d) storing of a second pointer P_{Ti} in said terminal control block BT,

whereby said first pointer P_{iT} points to said terminal control block BT and said second pointer P_{Ti} points to said control block B_i .

12. Method according to claim 10 or 11, said computer system further comprising a user simulation program (7) and a dedicated virtual terminal VT_c (14) which is assigned to said user simulation program, said method being characterized by the following steps:

- a) selecting an applications program A_j out of said plurality of application programs,
- b) selectively establishing one or more logical connections C_i , C_j between said user simulation program and said dedicated virtual terminals VT_i , VT_j of said applications programs A_i , A_j ,
- c) selectively establishing a logical connection C_T between said terminal T and said dedicated virtual terminal VT_c of said user simulation program.

13. Computer system or method according to any one of the preceding claims, characterized in that said dedicated virtual terminal comprises a virtual terminal buffer VTA1, VTA2, VTT1 which is stored in a main memory of said computer system independently from the existence of a logical connection between said terminal T or - if present - said user simulation program and said dedicated virtual terminal.

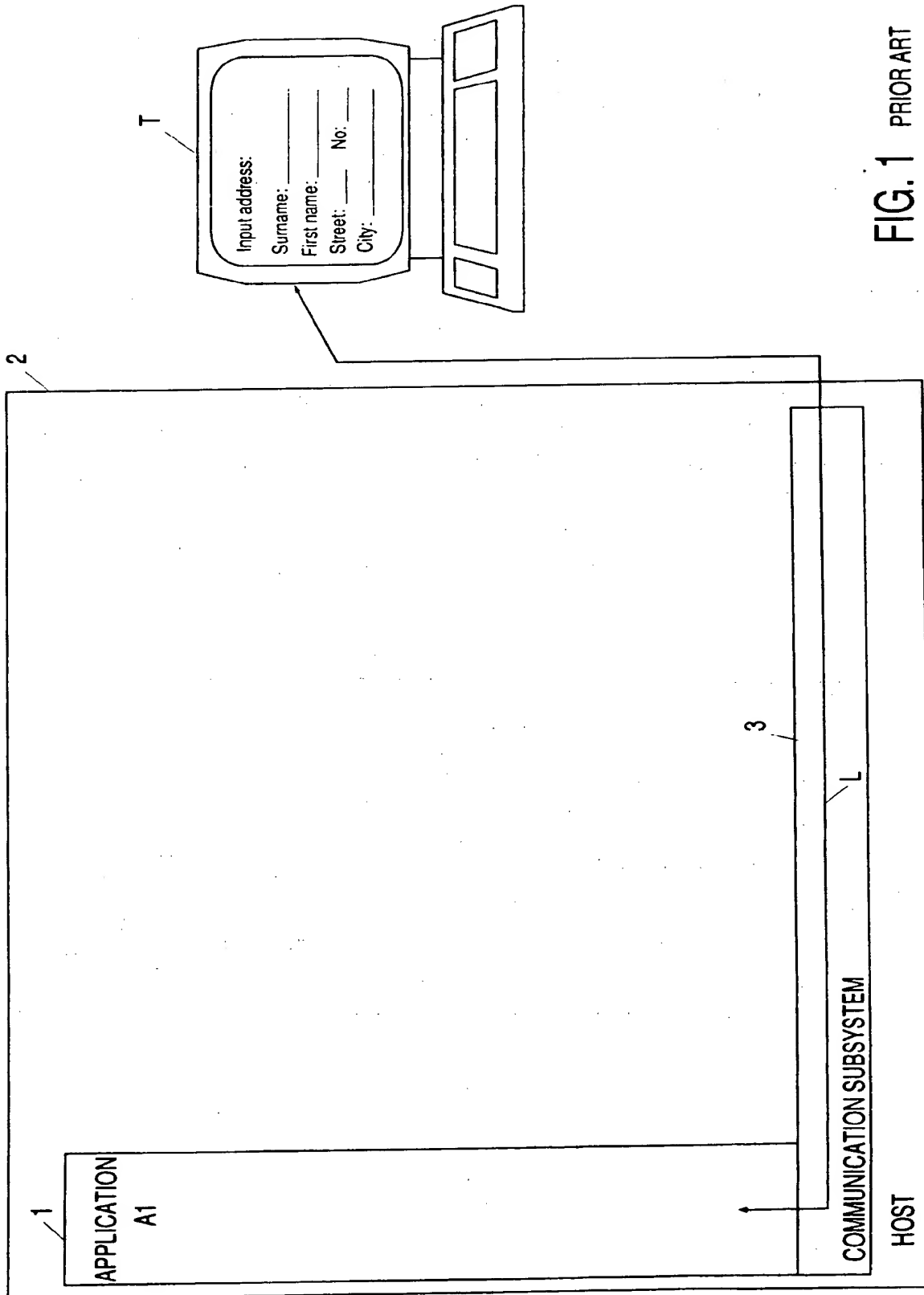


FIG. 1 PRIOR ART

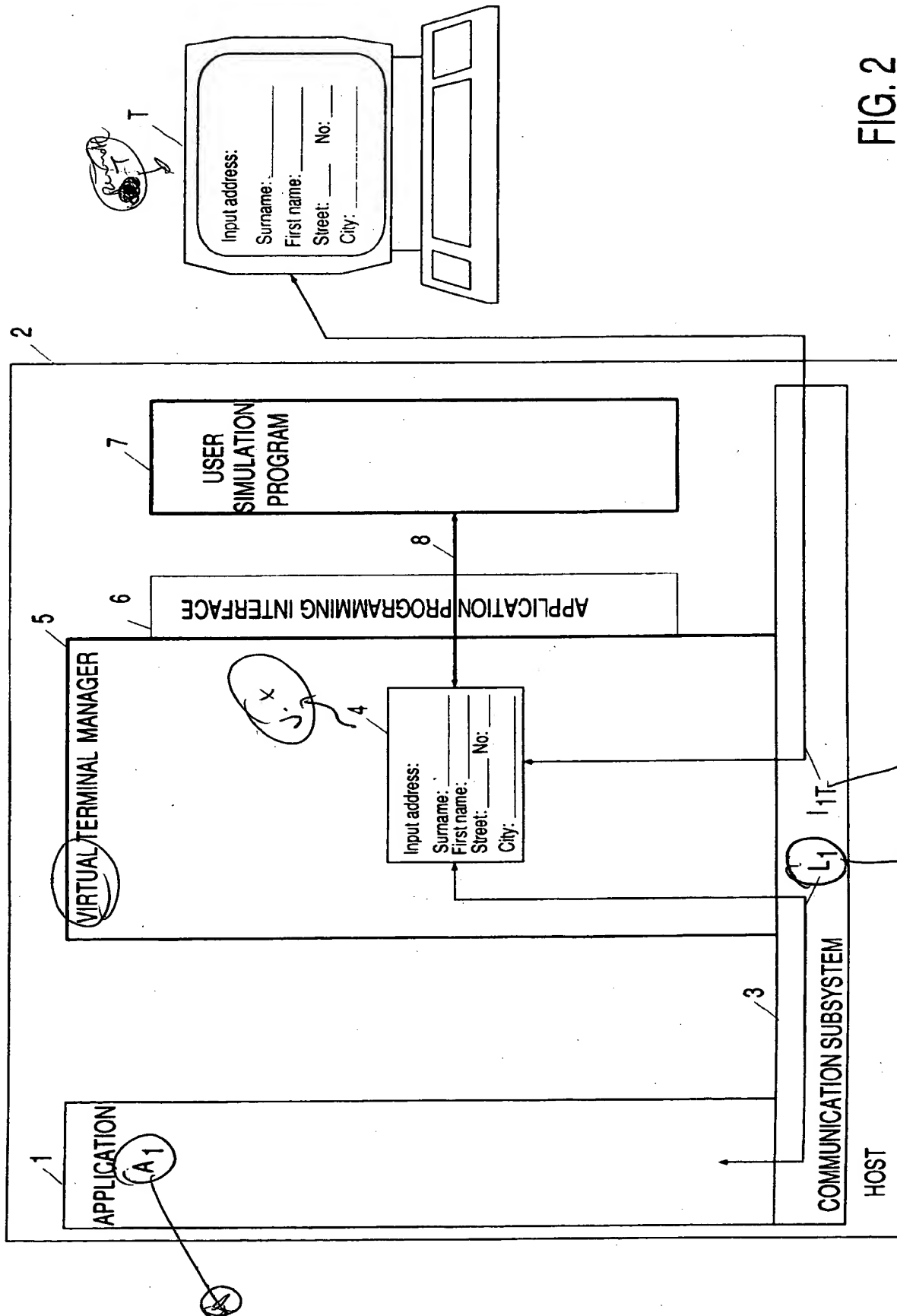


FIG. 2

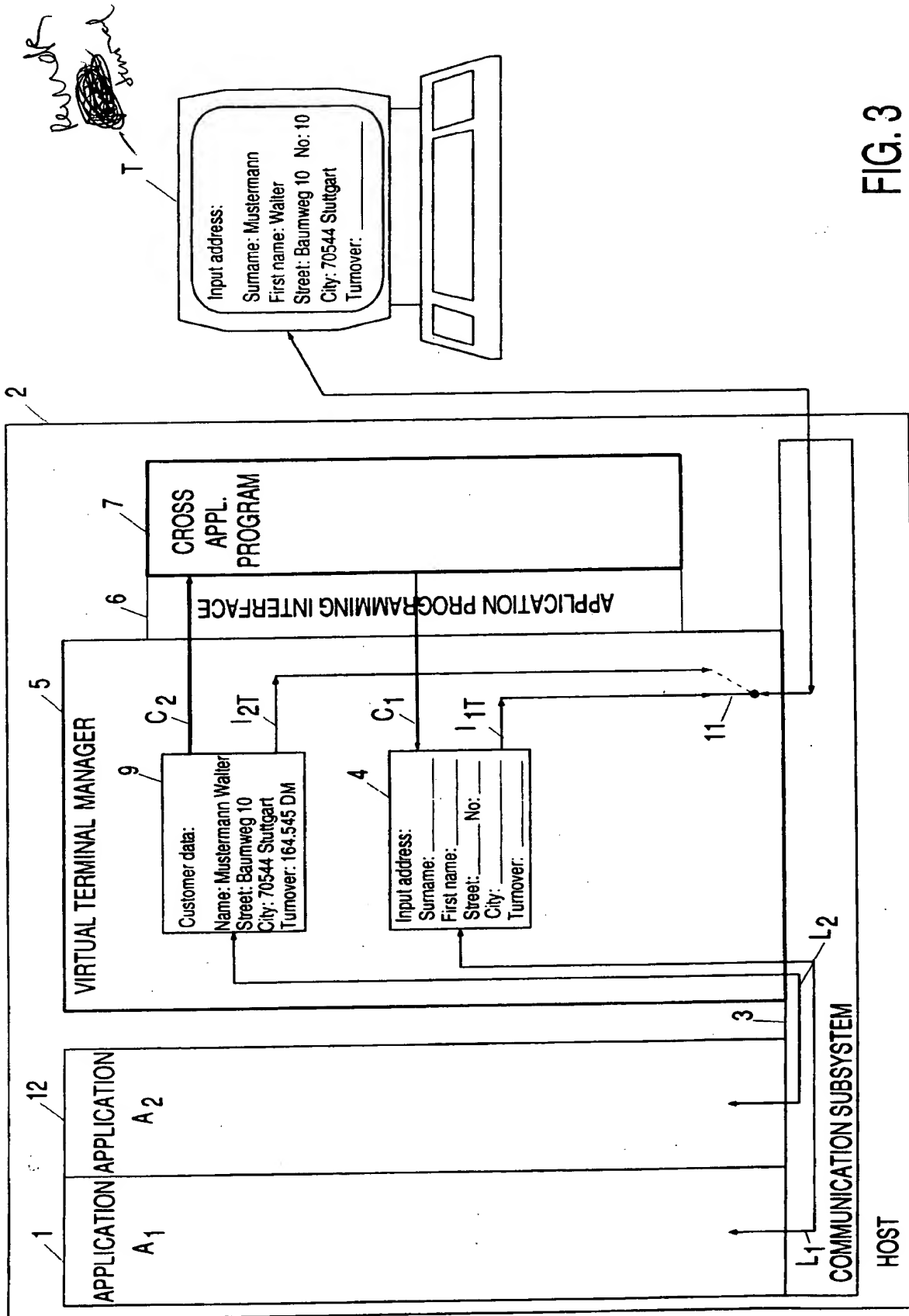


FIG. 3

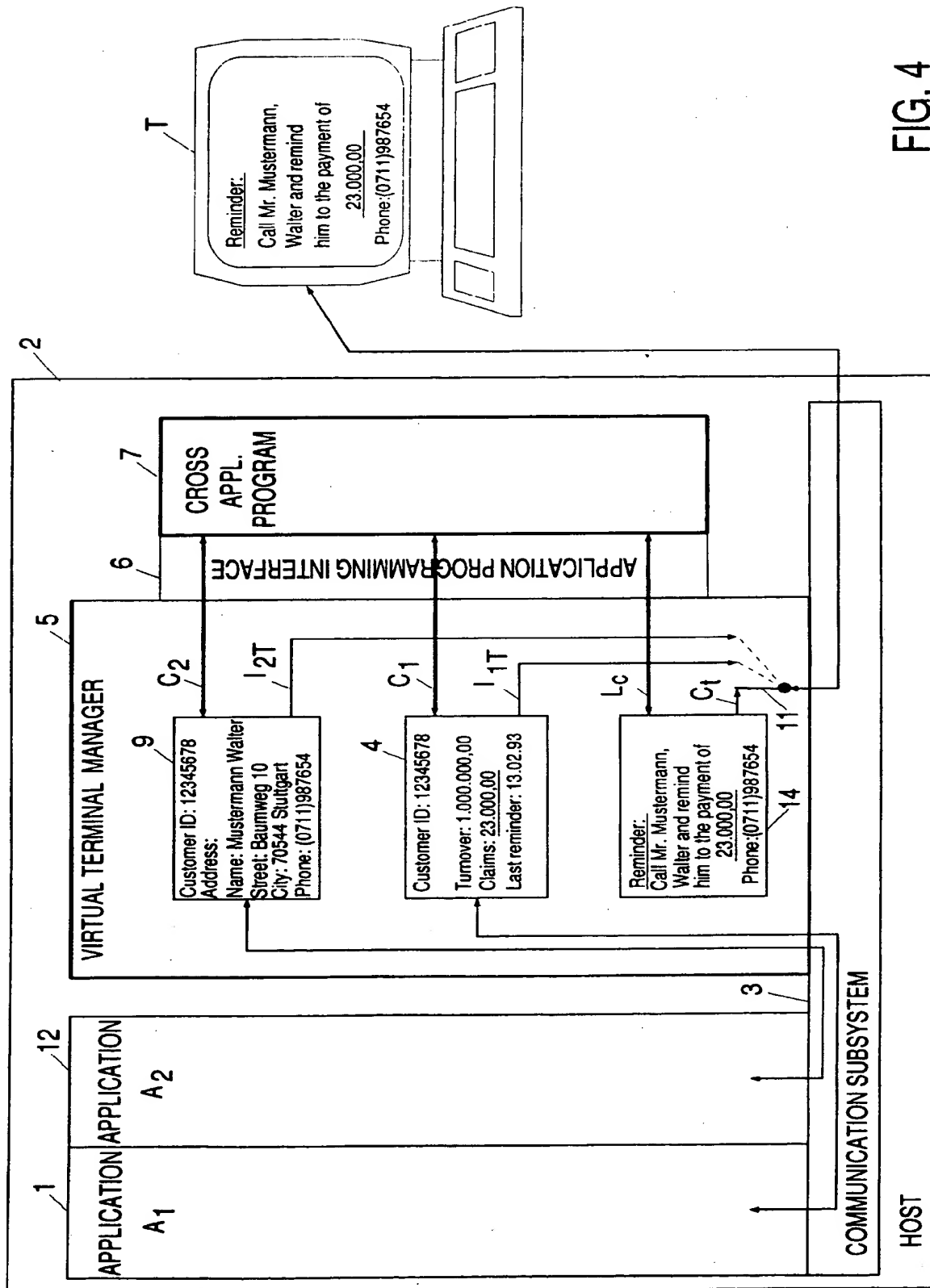


FIG. 4

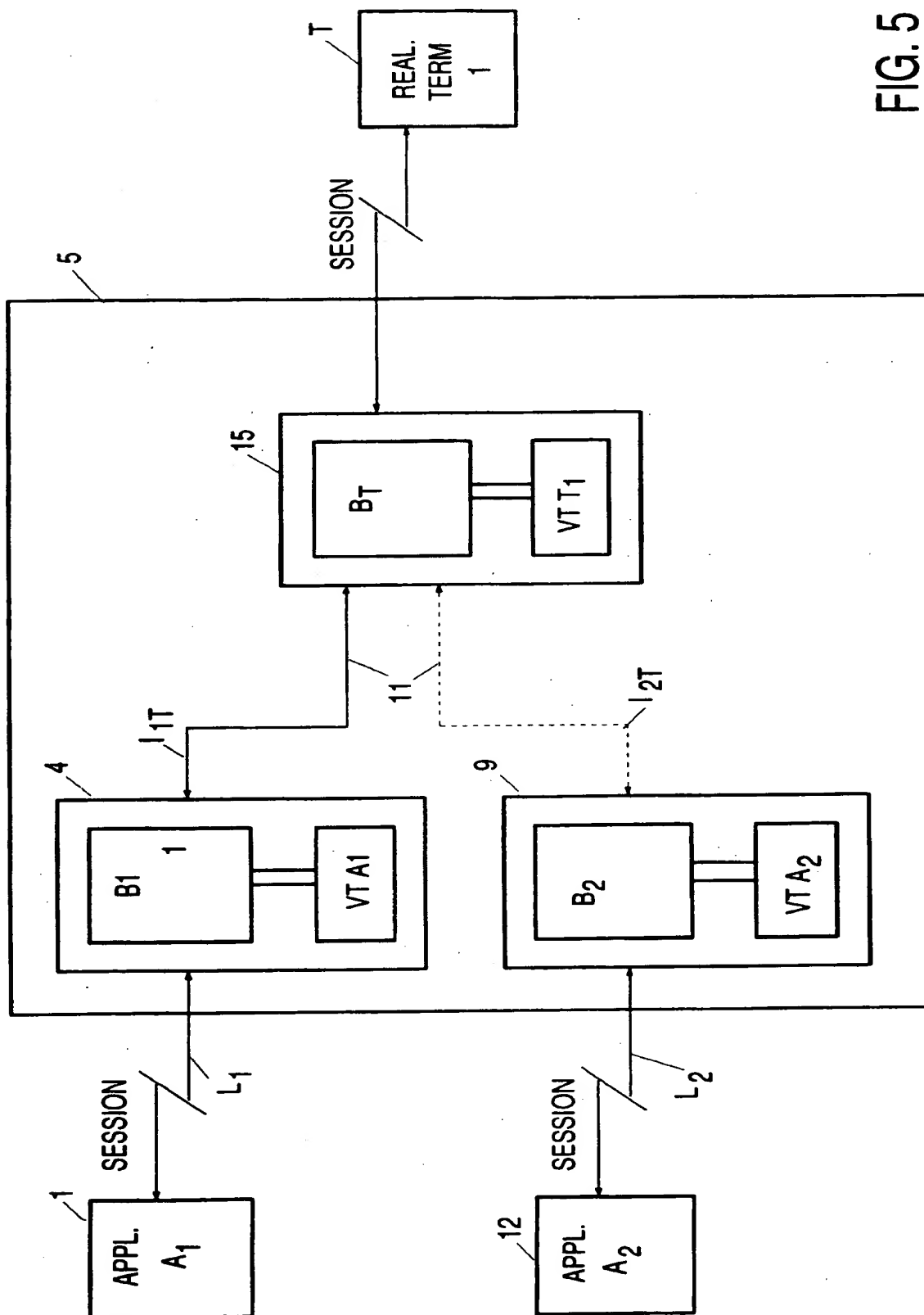


FIG. 5

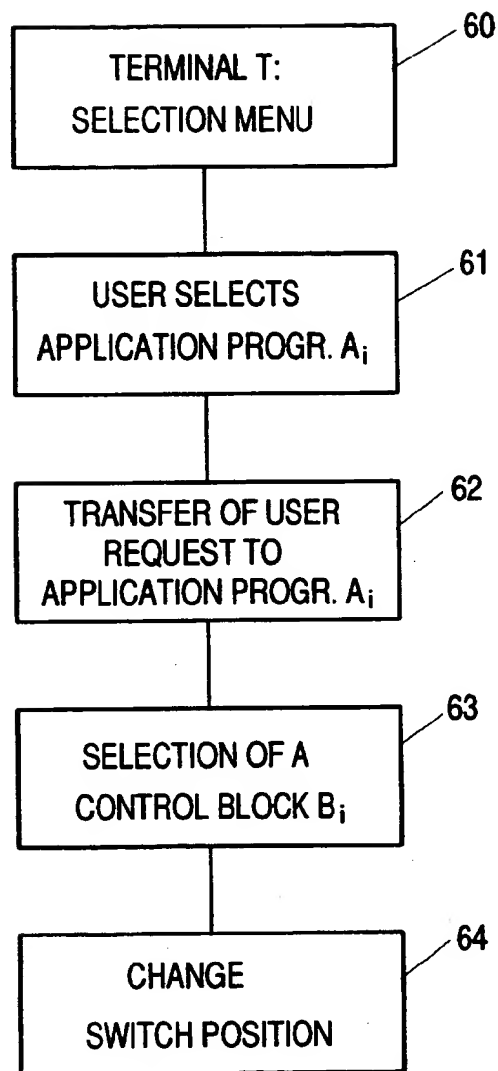


FIG. 6

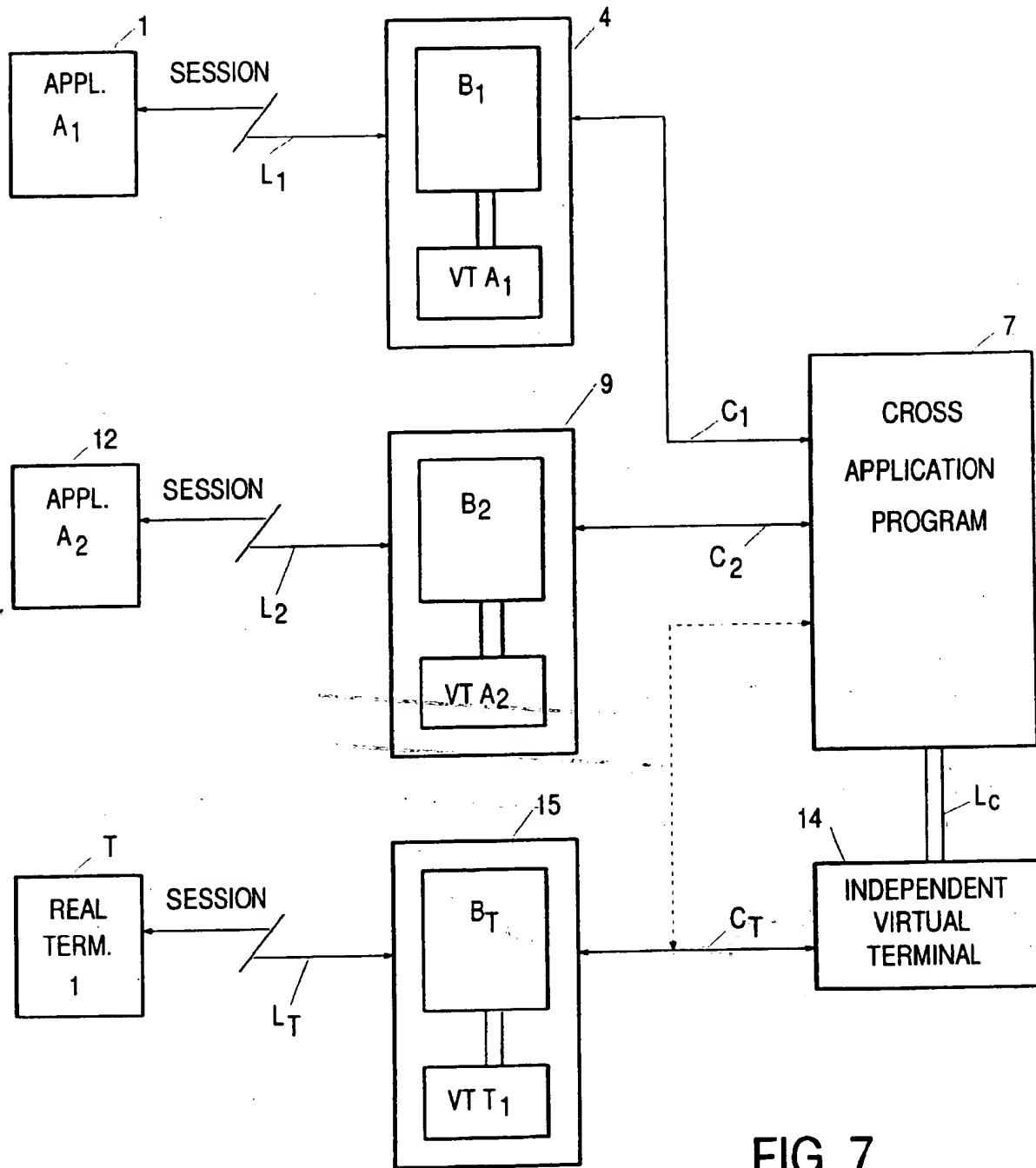


FIG. 7



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Application Number
EP 93 11 4714

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)		
X	PATENT ABSTRACTS OF JAPAN vol. 11, no. 311 (P-625)12 October 1987 & JP-A-62 100 854 (NEC) 11 May 1987	1,8,10	G06F9/46 G06F3/023		
Y	* abstract *	2-4,11			
Y	EP-A-0 362 709 (IBM) * abstract * * page 3, column 4, line 7 - line 15; figure 1 *	2-4,11			
A	PATENT ABSTRACTS OF JAPAN vol. 15, no. 296 (P-1231)26 July 1991 & JP-A-31 002 551 (NEC) 26 April 1991 * abstract *	5,12			
D,A	EP-A-0 229 336 (IBM) * page 8, line 26 - page 9, line 24 *	1,10,13			
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)		
			G06F		
DOCKET NO: G2 98 P1387					
SERIAL NO: 09/272 015					
APPLICANT: <u>Hennipit al</u>					
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The present search report has been drawn up for all claims					
Place of search	Date of completion of the search	Examiner			
THE HAGUE	17 February 1994	Gill, S			
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